

## BRYOPHYTE FLORA OF WILLIAM L. FINLEY NATIONAL WILDLIFE REFUGE, WILLAMETTE VALLEY, OREGON

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### ABSTRACT

The Willamette Valley in northwestern Oregon is a mosaic of plant communities, some of which have become rare following European settlement. William L. Finley National Wildlife Refuge preserves examples of many of these historic communities, which provide diverse substrates for bryophytes. Mosses and liverworts were collected at the refuge from 1993 through 1999. Eighty-four moss and 24 liverwort species were identified and their substrates cataloged. The moss *Physcomitrella patens* (Hedwig) Bruch, Schimper & GümbeI is newly reported for Oregon. The rarity of some common Pacific Northwest species at Finley Refuge may be a function of the drier climate in the Willamette Valley than in the surrounding mountain ranges. Land at Finley Refuge is managed primarily for wildlife species, but the protection of natural and pre-settlement plant communities has resulted in conditions facilitating a rich bryophyte flora.

The Willamette Valley in northwestern Oregon provides a diversity of bryophyte substrates that differ from those in the surrounding mountain forests because of its contrasting climate and vegetation. The presence of hardwoods as well as conifers, open as well as closed canopies, wetlands as well as uplands, and human-altered as well as natural landscapes provide a plethora of substrates supporting a rich bryoflora. Willamette Valley bryophytes have been variously surveyed (Sanborn 1929; Chapman and Sanborn 1941; Pike 1973; Pike et al. 1975), but no intensive collections of all substrates within a defined geographic area have been made. This study of a representative Willamette Valley location appears to be the first inventory of all substrates within such a defined area.

Warmer and drier than the surrounding mountains, the Willamette Valley is a broad depression between the Coast and Cascade Ranges, extending from the Columbia River south to the convergence of the two ranges at Cottage Grove (Franklin and Dyrness 1973). While average yearly rainfall in the Cascades and Coast Range averages 200 to 340 cm, only about 100 cm falls in the Willamette Valley, and potential evapotranspiration far exceeds winter moisture buildup due to hot, dry summers (Habeck 1961; Franklin and Dyrness 1973).

The Willamette Valley is a mosaic of deciduous and coniferous forests, savannahs, grasslands, and wetlands (Johannessen et al. 1971; Franklin and Dyrness 1973). Oak forests and savannahs are dominated by *Quercus garryana* Hook. *Acer macrophyllum* Pursh, *Pseudotsuga menziesii* (Mirbel) Franco, and *Arbutus menziesii* Pursh may be co-dominant. *Pseudotsuga menziesii* dominates in coniferous forests, but *Abies grandis* (Douglas) Lindley and *A. macrophyllum* are also widespread. *Fraxinus latifolia* Benth. forests are common in seasonally flooded areas, especially along streams.

Prairies occupied extensive tracts of the Willamette Valley before it was settled; they are still widespread but now harbor many exotic species (Habeck 1961; Franklin and Dyrness 1973). These pre-settlement Willamette Valley prairies and savannahs may have been seral communities created and maintained by fire (Habeck 1961; Johannessen et al. 1971). Fire control has permitted the development of oak forests, and nearly all of the remaining prairie is currently being used for agriculture or grazing (Habeck 1961; Johannessen et al. 1971).

### METHODS

*Study Area.* William L. Finley National Wildlife Refuge comprises 2156 hectares (5325 acres) about 14 km south of Corvallis, Benton County, OR, in the Willamette Valley. Elevations vary from 77 to 189 m (255 to 620 ft). Several pre-settlement Willamette Valley plant communities are preserved within the refuge. Forests, oak savannahs, native wet prairies, swamps, and marshes are interspersed with agricultural fields of wildlife food and cover crops, which together make up 25% of the total area. Both pre-settlement and settler-altered vegetation are represented. The refuge was established primarily as habitat for dusky Canada geese, the southern population of which winters almost exclusively in the Willamette Valley (Palmer 1976). All other native plant and animal species are protected as well. Human perturbations are uncommon outside of agriculture and of road building and maintenance and are strictly controlled.

Several Willamette Valley bryophyte substrates are especially well preserved at the refuge. Willamette Valley native wet prairie is a substrate now unique to Finley Refuge and only a few other sites. In these prairies, soil accumulation around graminoid hummocks forms vertical surfaces saturated during the winter but desiccated in summer. Forest

substrates include the bark of oaks and maples up to 250 years old, rotting logs and stumps, and forest floor litter and soil. Weathered rocks and cervid bones and antlers remain undisturbed in forests. Freshly dug forest, edge, and upland prairie soil is often present because moles, gophers, and voles are not artificially controlled. The bark of isolated oaks in savannahs and agricultural fields support a bryophyte assemblage distinct from that of forests. Vernal pool conditions are common in agricultural fields because wildlife food crop fields are worked in late summer or fall, rather than in spring as commercial agricultural crops are, leaving poorly drained areas undisturbed through spring and early summer. In addition, swamp mud, wet rocks or branches in and near streams, seasonally flooded shaded soil along streams, and upland grasslands are well represented. Because some roads are rarely used or maintained, roadbeds and compacted gravel remain undisturbed for long periods. Pigeon Butte, a sandstone hill bounded on the south by a basalt dike, provides both naturally exposed and quarried basalt. Scattered basalt boulders are also present on other hilltops.

*Bryophyte Inventory.* From February 1993 through August 1999, Finley Refuge was traversed on foot for the purpose of collecting bryophytes to make as complete an inventory as possible. Specimens were collected from all known substrates in all natural and human-influenced systems. The vascular plant community and substrate of each specimen was recorded. Except as otherwise noted, collections were identified by K. Merrifield using standard taxonomic works (Howe 1899; Schuster 1969; Lawton 1971; Schuster 1974; Schuster 1977; Crum and Anderson 1981; Smith 1990; Christy and Wagner 1996). Taxa newly or rarely reported for Oregon were confirmed or corrected by one or more of the following: W. F. Schofield and J. Harpel of the University of British Columbia, J. Christy of the Oregon Natural Heritage Program, and V. Bryan of Duke University. Voucher specimens of each species, and of each variety where applicable, as well as additional specimens from varying substrates, were placed in the Oregon State University Herbarium (OSC). Duplicate specimens were placed in the cryptogamic collection at Finley Refuge.

## RESULTS

The bryophyte flora of Finley Refuge consists of 108 species, including 84 moss and 24 liverwort species, and 67 genera, including 52 moss and 15 liverwort genera. At least one hornwort, *Anthoceros* sp. *sensu lato*, was present. The largest moss family was Brachytheciaceae, represented by 14 species, followed by Bryaceae (8 species), Pottiaceae (8 species), Grimmiaceae (7 species), Dicranaceae (6 species), and Mniaceae (6 species). The largest liverwort family was Lophocoleaceae, rep-

resented by 5 species, followed by Jubulaceae and Porellaceae (3 species each.)

*Physcomitrella patens* (Hedwig) Bruch, Schimper & Gumbel is reported for the first time in Oregon in this study. Collections of *Syntrichia laevipila* Bridel var. *meridionalis* (Schimper) Juratzka made during this study along with collections from additional Willamette Valley localities were newly reported for Oregon earlier (Merrifield 2000). *Physcomitrium immersum* Sullivant and *Ephemerum serratum* (Hedwig) Hampe are both reported here for the second time in Oregon (Conard 1944; Christy 1980).

As of 1982, the known moss flora of Oregon comprised 411 species in 134 genera (Christy et al. 1982). About 20% of the statewide assemblage of moss species representing 39% of Oregon genera reside at Finley Refuge. Chapman and Sanborn (1941) documented 114 moss species in 60 genera in the entire Willamette Valley; 74% as many species and 87% as many genera were identified in this study. The known liverwort flora of Oregon comprises 168 species in 57 genera (D. H. Wagner unpublished). About 14% of the statewide assemblage of liverwort species representing 26% of Oregon genera were documented at Finley Refuge. Sanborn (1929) listed 116 liverwort species in 35 genera throughout western Oregon; 21% as many species and 43% as many genera were identified at Finley Refuge in this study.

## DISCUSSION

Bryophyte diversity increases as the number of suitable substrates increases (Slack 1977). In western Oregon Cascade and Coast Range sites, increased forest floor bryophyte diversity was positively correlated with the abundance of rocks, coarse woody debris, stand openings, and hardwoods (Rambo and Muir 1998). Hardwoods such as red alder and bigleaf maple often support rich epiphytic bryofloras that differ from those on conifers (Christy and Wagner 1996). Rainfall dripping through hardwoods is richer in nutrients than that of conifers, and hardwoods allow greater light transmittance than do conifers (Rambo and Muir 1998). In forests alone at Finley Refuge, therefore, several factors encouraging bryophyte diversity are present: deciduous forests are more extensive than coniferous, rocks are present, variously decomposed coarse woody debris is plentiful, and stand openings as well as edges are common. Oak savannahs, wetlands, and riparian communities contribute additional diverse substrates under a variety of conditions.

*Forests.* All 6 bryophyte species occurring on forest floor litter and soil were common at Finley Refuge. *Rhytidiadelphus triquetrus* was the most abundant, and it dominated the herbaceous layer in many areas. In addition, the branches of *Trachy-*

TABLE 1. TREE SUBSTRATES FOR BRYOPHYTES AT FINLEY REFUGE.

Latin name	Common name
<i>Acer circinatum</i> Pursh	Vine maple
<i>Acer macrophyllum</i> Pursh	Bigleaf maple
<i>Alnus rubra</i> Bongard	Red alder
<i>Crataegus douglasii</i> Lindley	Western hawthorne
<i>Fraxinus latifolia</i> Bentham	Oregon ash
<i>Physocarpus capitatus</i> (Pursh) Kuntze	Ninebark
<i>Populus balsamifera</i> L. spp. <i>trichocarpa</i> (Torrey & Gray) Brayshaw	Black cottonwood
<i>Pseudotsuga menziesii</i> (Mirbel) Franco	Douglas fir
<i>Quercus garryana</i> Hooker	Oregon white oak; Garry oak
<i>Salix</i> spp.	Willow

*bryum megaptitulum* adhered to litter, although plants originated on freshly dug forest soil.

Rotting logs harbored 37 species. Among the most abundant were *Antitrichia californica*, *Aulaconnum androgynum*, *Brachythecium frigidum*, *Dicranoweisia cirrata*, *Eurhynchium praelongum* var. *stokesii*, *Homalothecium fulgescens*, *Hypnum subimponens*, *Isothecium myosuroides*, *Plagiomnium venustum*, *Cephalozia bicuspidata*, and *C. lunulifolia*. The rotting log bryophyte assemblage is expected to contain a high proportion of the liverwort flora in the spruce-fir biome of North America (Schuster 1969, 1974, 1977; Christy and Wagner 1996). Accordingly, 8 liverwort species in the genera *Cephalozia*, *Cephalozia*, *Lepidozia*, *Lophocolea*, and *Scapania*, comprising 33% of the hepatic flora at Finley Refuge, were observed solely on rotting logs and branches.

The bark of living trees (Table 1) provided substrate for 35 species. *Antitrichia californica*, *Dendroalsia abietina*, *Dicranoweisia cirrata*, *Homalothecium fulgescens*, *H. nuttallii*, *Hypnum subimponens*, *Metaneckera menziesii*, *Neckera douglasii*, *Orthotrichum consimile*, *O. lyellii*, *Plagiomnium venustum*, *Porella navicularis*, and *P. roellii* were the most common. Bryophytes on shaded bark usually formed a continuous mat, while those that occurred on more exposed bark usually grew in small groups or discreet tufts. A solid mat of *M. menziesii* was especially characteristic of large forest oaks.

**Isolated Oaks.** The bryophyte assemblage of exposed, often sparsely shaded bark of isolated oaks comprised an unidentified, nonsporulating *Didymodon* species, *Dicranoweisia cirrata*, *Syntrichia ruralis*, *S. latifolia*, *S. laevipila* var. *meridionalis*, and *Zygodon viridissimus*, the latter three of which are gemmiparous (Merrifield 2000). In some collections in which *S. laevipila* var. *meridionalis* gametophores were not found, its gemmae were present among the other mosses. Areas where some or all of these 6 taxa coalesced were colonized by mosses more characteristic of shaded bark, such as *Homalothecium nuttallii*, *Metaneckera menziesii*, and *Dendroalsia abietina*.

**Upland Soils.** Thirty-eight bryophyte species occurred on soils. Disturbed, packed upland soil and

soil freshly disturbed by small mammals each harbored 9 species; *Tortula atheroides* and *Scleropodium touretii* were common to both. *Trachybryum megaptitulum* grew on mammal-dug forest soil. Only three bryophyte species, *Brachythecium albicans*, *Bryum lisae* var. *cuspidatum*, and *Dicranum scoparium*, inhabited upland prairie soils. The occurrence of the first two were limited. In contrast, extensive collections from many prairie localities indicated that *Brachythecium albicans* is a widespread and profuse grassland community component.

Because agricultural fields occupy about 25% of Finley Refuge land, and because some fields lie fallow for long periods, exposed agricultural soil is extensive. Of the three moss species inhabiting upland agricultural soils, *Bryum dichotomum* was by far the most abundant, covering vast expanses of soil unworked in spring.

**Wetland Soils.** Cumulative losses of bryophyte taxa in western Oregon, Washington, and California have probably been greatest for the wet soil species occurring on floodplains, where agricultural impacts have been concentrated (Christy and Wagner 1996). Due to preservation of several native wetland habitats and to crop management for wildlife rather than for market consumption, including leaving poorly drained field soils comparatively undisturbed, Finley Refuge continues to harbor elements of this bryophyte assemblage.

Several soil substrates were seasonally flooded. Primary succession on such recently disturbed soil includes many opportunistic bryophyte species (Christy and Wagner 1996). Both flat streamside soils and undrained soils in agricultural fields harbored vascular plants characteristic of vernal pools. *Physcomitrella patens*, *Leptodictyum riparium*, and *Riccia fluitans* were unique to streamside. *Dicranella heteromalla*, *Pohlia annotina*, and *Fossombronina wondraczekii* were unique to low, undrained areas in cultivated fields, and *Physcomitrium pyriforme* occurred on both streamside and undrained field soils. Several *Riccia* species from undrained soils remain to be identified (J. Wheeler personal communication). *Riccia fluitans* and *Ricciocaropus natans* were the only two free-floating species, and



they were also found stranded on streamside mud. *Ditrichum schimperi*, *Ephemerum serratum*, and a depauperate form of *Philonotis fontana* were unique to seasonally flooded native wet prairie vertical soil surfaces of graminoid hummocks. *Plagiomnium medium* and *P. ellipticum* were unique to the seasonally flooded mud of ash swamps.

Permanently shaded vertical soil surfaces along streams supported a unique bryophyte assemblage, including *Atrichum selwynii*, *Eurhynchium praelongum* var. *praelongum*, *Fissidens bryoides*, *Jungermannia rubra*, and *Riccardia multifida*.

*Rocks, Bones, and Antlers.* Basalt provided substrate for 30 species. The most common included *Dicranoweisia cirrata*, *Didymodon vinealis*, *Grimmia pulvinata*, *G. trichophylla*, *Homalothecium nuttallii*, *Orthotrichum lyellii*, *Racomitrium canescens*, and *R. heterostichum*. While a distinctive assemblage of Pacific Northwest bryophyte species occurs on rocks (Christy and Wagner 1996), some rock-dwelling species at Finley Refuge also occurred on other substrates. Overlap occurred among rotting log-, bark-, and basalt-dwellers, but only *Antitrichia californica*, *D. cirrata*, and *I. myosuroides* occurred on all three.

None of the moss species on basalt were among the 5 on weathered sandstone, which included *Fissidens bryoides* and *Scleropodium touretii*, also inhabitants of disturbed upland soils. Fifteen moss species occurred on concrete, and this was the only substrate on which *Amblystegium serpens* and *Tortula muralis* were found. No species were found on both concrete and sandstone. Only *Brachythecium frigidum*, *Eurhynchium praelongum* var. *praelongum*, and *Sanionia uncinata* occurred on bone and antler.

*Bryophytes Expected but Uncommon or Absent.* *Antitrichia curtispindula*, *Claopodium crispifolium*, *Scapania bolanderi*, and *Isothecium myosuroides* were less common than expected judging from accounts of Pacific Northwest bryoflora (Lawton 1971, Schofield 1976, Vitt et al. 1988). The first three were found only on forested north-facing slopes in isolated patches rather than broad mats. *Antitrichia curtispindula* requires humidity and is considered closely associated with late successional or old-growth forests (Schofield 1976, FEMAT 1993, Christy and Wagner 1996), but Chapman and Sanborn (1941) collected *A. curtispindula* as well as *C. crispifolium* throughout the Willamette Valley. *Scapania bolanderi* has often been collected in coastal regions (Howe 1899, Vitt et al. 1988) and Cascade slopes (Sanborn 1929) and is also considered closely associated with late-successional or old-growth forests (FEMAT 1993). *Isothecium myosuroides* was widespread at Finley Refuge but did not dominate forest epiphytes as it does at some Coast Range sites (Peck 1997).

Two mosses that were expected but not found at Finley Refuge were *Rhytidiadelphus loreus* (Hed-

wig) and *Hylocomium splendens* (Hedwig) Bruch, Schimper & Gumbel. Most of Chapman and Sanborn's (1941) collections of *R. loreus* were from the humid margins of the Willamette Valley, but their collections of *H. splendens* were on substrates and at elevations comparable to those at Finley Refuge. The absence of these species in this study may be a function of the relatively dry climate of the Willamette Valley or of this particular locality.

At Finley Refuge, land managed primarily for wildlife and for protection of natural systems preserves a variety of native and settler-altered plant communities that provide a wide range of substrates, resulting in a diverse and abundant bryophyte assemblage.

#### ANNOTATED SPECIES LIST

All substrates on which each taxon was found are listed. Moss nomenclature follows that of Anderson et al. (1990), except for that of Pottiaceae, which follow Zander (1993), and *Eurhynchium*, which follows Lawton (1971). Liverwort nomenclature follows that of Stotler and Crandall-Stotler (1977). Numbers following taxa and descriptions are Merrifield collection numbers retained as vouchers in OSC. The number followed by RH is a Richard Halse collection number.

#### Class Musci

- Amblystegium serpens* (Hedwig) Bruch, Schimper & Gumbel var. *juratzkanum* (Schimper) Rau & Hervey [Amblystegiaceae]. Concrete. 932c.
- Antitrichia californica* Sullivant in Lesquereux [Leucodontaceae]. Bark of Oregon white oak, willow sp., and black cottonwood; rotting deciduous log, burned log, exposed basalt, shaded basalt, concrete. 605, 610, 1179.
- Antitrichia curtispindula* (Hedwig) Bridel [Leucodontaceae]. Bark of Douglas fir and red alder, rotting vine maple; unidentified rock; all deeply shaded. 1181.
- Atrichum selwynii* Austin [Polytrichaceae]. Stream-cut bare soil bank. 1383.
- Aulacomnium androgynum* (Hedwig) Schwaegrichen [Aulacomniaceae]. Bigleaf maple log, unidentified deciduous log, basalt. 632, 651.
- Brachythecium albicans* (Hedwig) Schimper in Bruch, Schimper & Gumbel [Brachytheciaceae]. Soil among grass in savannah, upland grasslands, and lawn; packed soil; shaded basalt. 966, 977, 1700c.
- Brachythecium frigidum* (C. Müller) Beschereille [Brachytheciaceae]. Rotting bigleaf maple log, butt of rotting bigleaf maple, damp log in streambed, weathered unidentified rock, permanently shaded basalt in depression below soil line, shaded basalt above ground, clay soil among emergents, mud among *Carex* under Oregon white oak and Oregon ash, clay soil among emergents, fallen branch in mud, deer skull and antlers,

- Gandoderma*-complex fruiting structure on log. 871, 979, 1187, 1418, 1692.
- Brachythecium rivulare* Schimper in Bruch, Schimper & GümbeI [Brachytheciaceae]. Moist, shaded basalt; dry, exposed rock; rock in flowing water; mud among *Carex* under Oregon white oak and Oregon ash; rotting bigleaf maple log; white-rotted standing bigleaf maple butt. 674, 677, 974, 975, 1385b.
- Bryum argenteum* Hedwig [Bryaceae]. Totally unshaded basalt in natural outcrop. 1428.
- Bryum caespiticum* Hedwig [Bryaceae]. Agricultural field soil. 1224.
- Bryum canariense* Bridel [Bryaceae]. Basalt, concrete, soil over concrete, soil between rocks in gravel road. 791.
- Bryum capillare* Hedwig [Bryaceae]. Rotting log, weathered stump roots, soil between uprooted tree roots, concrete, shaded basalt, packed soil, hummock in wet prairie. 649, 943, 1700b.
- Bryum dichotomum* Hedwig [Bryaceae]. Packed soil at agricultural field edge, disturbed soil among grass at field edge, packed road soil. 1222, 1227b.
- Bryum lisae* De Notaris var. *cuspidatum* (Bruch, Schimper & GümbeI) Margot [Bryaceae]. Concrete, packed soil among grasses. 932b.
- Ceratodon purpureus* (Hedwig) Bridel [Ditrichaceae]. Exposed basalt, shaded basalt, packed soil. 785, 962.
- Claopodium crispifolium* (Hooker) Renauld & Cardot [Leskeaceae]. Bigleaf maple bark and weathered sandstone, both deeply shaded. 1175.
- Dendroalsia abietina* (Hooker) Britton [Leucodontaceae]. Rotting deciduous and Douglas fir logs; bark of Oregon white oak, Douglas fir and black cottonwood bark. 609.
- Dicranella heteromalla* (Hedwig) Schimper [Dicranaceae]. Drying undrained agricultural soil. 1459b.
- Dicranoweisia cirrata* (Hedwig) Lindberg ex. Milde [Dicranaceae]. Oregon white oak bark, rotting Oregon white oak log, burned log, split wood fenceposts, basalt, packed road soil. 620, 623, 1227a.
- Dicranum fuscescens* Turner [Dicranaceae]. Rotting Douglas fir bark. 661, 681.
- Dicranum howellii* Renauld & Cardot [Dicranaceae]. Rotting Oregon white oak, rotting bigleaf maple stump, bigleaf maple bark. 621, 1178.
- Dicranum scoparium* Hedwig [Dicranaceae]. Rotting bigleaf maple stump, soil among grasses. 660a, 1687.
- Dicranum tauricum* Sapehin [Dicranaceae]. Sides and cross section of rotting bigleaf maple and Douglas fir stumps. 681a.
- Didymodon vinealis* (Bridel) Zander [Pottiaceae]. Concrete, freshly disturbed soil, exposed basalt. 934b, 951.
- Didymodon* sp. [Pottiaceae]. Bark of isolated Oregon white oaks. 1676b.
- Ditrichum shimperi* (Lesquereux) Kuntze [Ditrichaceae]. Shaded soil of native wet prairie hummock. 1572.
- Ephemerum serratum* (Hedwig) Hampe [Ephemeraeae]. Soil of hummock in native prairie. 1570 [det. by V. Bryan].
- Eurhynchium oregonum* (Sullivant) Jaeger [Brachytheciaceae]. Vine maple bark, rotting Douglas fir log, Douglas fir butt, basalt, soil over rock. 617.
- Eurhynchium praelongum* (Hedwig) Bruch, Schimper & GümbeI var. *praelongum* [Brachytheciaceae]. Woody debris among *Carex*, creekbank soil, damp upland soil, ash swale soil, shaded weathered sandstone, concrete, gravel in flowing stream, lawn, branches in stream splash zone, ninebark root in dry streambed, butt of bigleaf maple log, deer skull and antlers. 634, 984b.
- Eurhynchium praelongum* (Hedwig) Bruch, Schimper & GümbeI var. *stokesii* Turner [Brachytheciaceae]. Rotting Oregon white oak, butt of bigleaf maple log, forest floor litter. 613, 1212.
- Fissidens bryoides* Hedwig [Fissidentaceae]. Clay stream bank, freshly disturbed soil, weathered sandstone, ditch at field edge. 874, 877, 1186, 1287.
- Fontanalis antipyretica* Hedwig var. *antipyretica* [Fontinalaceae]. Rocks in flowing water, submerged tree root, ninebark root in dry streambed. 1185.
- Funaria hygrometrica* Hedwig [Funariaceae]. Burned soil, burned wood, weathered stump roots, agricultural field soil, mud. 835.
- Grimmia incurva* Schwaegrichen [Grimmiaceae]. Exposed basalt. 1424.
- Grimmia pulvinata* (Hedwig) Smith [Grimmiaceae]. Basalt, concrete. 782, 1048, 1682b.
- Grimmia trichophylla* Greville [Grimmiaceae]. Basalt, concrete. 783, 942, 952, 1046, 1057, 1431.
- Homalothecium aeneum* (Mitten) Lawton [Brachytheciaceae]. Exposed basalt. 790.
- Homalothecium fulgescens* (Mitten ex C. Müller) Lawton [Brachytheciaceae]. Bark of bigleaf maple, hawthorne, Oregon ash, and Oregon white oak; fallen bigleaf maple branches, rotting unidentified log, rotting lumber, exposed rock, shaded basalt, concrete. 643, 666, 673a, 1054, 1690.
- Homalothecium nuttallii* (Wilson) Jaeger [Brachytheciaceae]. Bark of western hawthorne, black cottonwood and Oregon white oak; burned log, exposed unidentified rock, basalt, concrete, freshly disturbed soil. 616, 673b, 680.
- Hypnum circinale* Hooker [Hypnaceae]. Rotting Oregon white oak and unidentified stump, Oregon ash bark, rotting stump, exposed unidentified rock. 625, 1210.
- Hypnum subimponens* Lesquereux [Hypnaceae]. Basalt, rotting Oregon ash and unidentified logs and branches, Oregon ash bark, bigleaf maple butt, shaded basalt. 1183, 1188, 1691.



- Isothecium cristatum* (Hampe) Robinson [Brachytheciaceae]. Douglas fir bark; Douglas fir and unidentified stumps; rotting Oregon white oak, bigleaf maple, and unidentified logs. 644, 662, 1189, 1216.
- Isothecium myosuroides* Bridel [Brachytheciaceae]. Bark of Oregon ash, Douglas fir and Oregon white oak, rotting Oregon white oak and bigleaf maple logs, rotting branches of Douglas fir and Oregon ash, unidentified rock. 612, 1172.
- Leptobryum pyriforme* (Hedwig) Wilson [Bryaceae]. Freshly disturbed soil. 988d.
- Leptodictyum riparium* (Hedwig) Warnstorf [Amblystegiaceae]; soil in and near stream at agricultural field edge. 669.
- Leucolepis acanthoneuron* (Schwaegrichen) Lindberg [Mniaceae]. Oregon ash roots, rotting bigleaf maple and Douglas fir logs, basalt, shaded weathering sandstone, shaded soil. 635, 1060.
- Metaneckera menziesii* (Hooker in Drummond) Steere [Neckeraceae]. Bark of bigleaf maple, Oregon ash, and Oregon white oak. 1231.
- Neckera douglasii* Hooker [Neckeraceae]. Oregon white oak bark, Douglas fir branches, unidentified rock. 611.
- Orthotrichum consimile* Mitten [Orthotrichaceae]. Recently fallen Oregon ash and unidentified branches, burned log, basalt, concrete. 633, 1157a, 1158, 1288.
- Orthotrichum lyellii* Hooker and Taylor [Orthotrichaceae]. Bark of bigleaf maple, western hawthorne, Oregon ash, black cottonwood, Oregon white oak, burned log, basalt, shaded basalt. 615, 1058, 1157, 1265.
- Orthotrichum speciosum* Nees ex Sturm [Orthotrichaceae]. Black cottonwood bark. 1113.
- Philonotis fontana* (Hedwig) Bridel [Bartramiaceae]. Side of mud hummock in wet prairie; one small collection of depauperate specimen. 1569.
- Physcomitrella patens* (Hedwig) Bruch & Schimper in Bruch, Schimper & Gümbel [Funariaceae]. Shaded mud under bridge. 1156a [det confirmed by J. Christy].
- Physcomitrium immersum* Sullivant [Funariaceae]. Shaded mud along streams and under bridge, streamside mud. 1156b [det. confirmed by W. B. Schofield].
- Physcomitrium pyriforme* (Hedwig) Hampe [Funariaceae]. Packed mud, drying undrained agricultural soil. 1410.
- Plagiomnium ellipticum* (Bridel) T. Koponen [Mniaceae]. Clay soil under Oregon ash. 872.
- Plagiomnium insigne* (Mitten) T. Koponen [Mniaceae]. Rotting bigleaf maple, Douglas fir, and unidentified logs, unidentified rock near stream, forest soil, gravity-disturbed soil bank. 655c, 671, 686, 982, 1117, 1190, 1219.
- Plagiomnium medium* (Brusch & Schimper in Bruch, Schimper & Gümbel) T. Koponen [Mniaceae]. Clay soil under Oregon ash. 1159, 1168.
- Plagiomnium venustum* (Mitten) T. Koponen [Mniaceae]. Bark of Oregon ash and Oregon white oak, rotting bigleaf maple and Oregon white oak logs, exposed basalt, shaded basalt, unidentified rock. 606, 622, 1050.
- Plagiothecium laetum* Schimper in Bruch, Schimper & Gümbel [Plagiotheciaceae]. Rotting bigleaf maple and unidentified deciduous log. 631, 659.
- Pleuridium subulatum* (Hedwig) Rabenhorst [Ditrichaceae]. Freshly disturbed soil. 988b.
- Pohlia annotina* (Hedwig) Lindberg [Bryaceae]. Drying undrained agricultural soil. 1455, 1561.
- Polytrichum juniperinum* Hedwig [Polytrichaceae]. Overgrown roadbed, exposed basalt, soil in depression in shaded basalt. 780, 1045.
- Polytrichum piliferum* Hedwig [Polytrichaceae]. Exposed basalt. 1434.
- Pterogonium gracile* (Hedwig) Smith [Anomodontaceae]. Oregon white oak bark, fallen angiosperm bark, barkless Oregon white oak log, unidentified rotting log. 612, 648, 1416, 1673.
- Ptycomitrium gardneri* Lesquereux [Ptychomitriaceae]. Basalt. 1043, 1051.
- Racomitrium canescens* (Hedwig) Bridel [Grimmiaceae]. Overgrown gravel roadbed, rocky soil, basalt. 779, 1044.
- Racomitrium heterostichum* (Hedwig) Bridel [Grimmiaceae]. Dry, exposed basalt; shaded basalt, and unidentified rock. 672, 788, 1385, 1433, 1696.
- Racomitrium occidentale* (Renauld & Cardot) Renauld & Cardot [Grimmiaceae]. Partially shaded basalt. 1053.
- Rhizomnium glabrescens* (Kindberg) T. Koponen [Mniaceae]. Unidentified rotting log. 1114.
- Rhytidiadelphus triquetrus* (Hedwig) Warnstorf [Hylocomiaceae]. Deciduous sapling bark, Oregon ash bark, forest floor litter, shaded basalt, soil over rock. 619.
- Sanionia uncinata* (Hedwig) Loeske [Amblystegiaceae]. Rotting Oregon ash branch, shaded wooden bridge support, shaded deer skull and antlers on forest floor. 1167, 1382.
- Schistidium apocarpum* (Hedwig) Brusch & Schimper in Bruch, Schimper & Gümbel [Grimmiaceae]. Shaded basalt. 1689.
- Scleropodium cespitosum* (C. Müller) L. Koch [Brachytheciaceae]. Oregon white oak upper branch and butt bark. 1284b, 1678, 1681, 1683.
- Scleropodium obtusifolium* (Jaeger) Kindberg in Macoun & Kindberg [Brachytheciaceae]. Streambed gravel. 984a, 972, 1220.
- Scleropodium touretii* (Bridel) L. Koch var. *touretii* [Brachytheciaceae]. Packed soil, disturbed loose forest soil, shaded weathered sandstone, soil among road rocks. 960, 976, 985, 1195.
- Syntrichia laevipila* Bridel var. *laevipila* [Pottiaceae]. Bark of Oregon white oak in small, open group in agricultural fields and savannahs. With the var. *laevipila*, 1198, 1684a, 1685a, 1685b.
- Syntrichia laevipila* Bridel var. *meridionalis*

- (Schimper) Juratzka [Pottiaceae]. Bark of isolated Oregon white oak in agricultural fields and savannahs, with var. *laevipila*. 1198, 1684a, 1685a, 1685b [det. confirmed by J. Harpel].
- Syntrichia latifolia* (Hartman) Hübener [Pottiaceae]. Oregon white oak bark, shaded concrete. 946, 1197, 1684b, 1685b.
- Syntrichia princeps* (De Notaris) Mitten [Pottiaceae]. Oregon white oak bark, weathered stump roots, basalt, burned log, concrete. 930, 951, 1049, 1284a.
- Syntrichia ruralis* (Hedwig) Weber & Mohr [Pottiaceae]. Basalt, Oregon white oak bark, especially in savannahs. 1059, 1677b, 1685c, 1686.
- Tetraphis pellucida* Hedwig [Tetraphidaceae]. Rotting bigleaf maple log. 658.
- Timiella crassinervis* (Hampe) L. Koch [Pottiaceae]. Freshly disturbed partially shaded soil. 988c.
- Tortula atheroides* Zander [Pottiaceae]. Packed soil, freshly disturbed soil. 963, 990.
- Tortula muralis* Hedwig [Pottiaceae]. Concrete. 954.
- Trachybryum megaptulum* (Sullivant) Schofield [Brachytheciaceae]. Disturbed forest soil, forest floor litter, exposed rotting wood and adjacent disturbed soil, exposed concrete. 980, 981a.
- Zygodon viridissimus* (Dickson) Bridel var. *viridissimus* [Orthotrichaceae]. Savannah oak bark. 1675a, 1677a.

#### Class Hepaticae

- Cephalozia bicuspidata* (L.) Dumortier [Cephaloziaceae]. Rotting unidentified log, among mosses on basalt, on and among *Didymodon* sp. on savannah oak bark. 882.
- Cephalozia lunulifolia* (Dumortier) Dumortier [Cephaloziaceae]. Rotting bigleaf maple log. 655a.
- Cephaloziellaceae divaricata* (Smith) Schiffner [Cephaloziellaceae]. Rotting bigleaf maple log. 654a.
- Chyloscyphus polyanthos* (L.) Corda var. *polyanthos* [Lophocoleaceae]. Bare soil in Oregon ash swale, on soil among *Carex* sp. under Oregon white oak and Oregon ash. 870.
- Chyloscyphus polyanthos* (L.) Corda var. *rivularis* (Schrader) Nees [Lophocoleaceae]. Streambed. 668.
- Fossombronia wondraczekii* (Corda) Dumortier [Codoniaceae]. Drying undrained agricultural soil. 1560.
- Frullania bolanderi* Austin [Jubulaceae]. Oregon white oak bark. 624.
- Frullania californica* (Austin) Evans [Jubulaceae]. Oregon white oak bark. 925.
- Frullania tamarisci* (L.) Dumort ssp. *nisquallensis* (Sullivant) Hattori [Jubulaceae]. Oregon ash bark, Douglas fir bark. 636, 1115.
- Jungermannia rubra* Gottsche ex Underwood [Lophoziaceae]. Streambank mud. 878.
- Lepidozia reptans* (L.) Dumortier [Lepidoziaceae]. Rotting stump. 1209.
- Lophocolea bidentata* (L.) Dumortier [Lophocoleaceae]. Rotting bigleaf maple; rotting unidentified logs and branches. 653, 1381.
- Lophocolea cuspidata* (Nees) Limpricht [Lophocoleaceae]. Rotting unidentified log. 881.
- Lophocolea heterophylla* (Schrader) Dumortier [Lophocoleaceae]. Rotting bigleaf maple log, rotting unidentified stump. 655b, 1213.
- Marchantia polymorpha* L. [Marchantiaceae]. Perpetually wet concrete, soil in ash swale, moist disturbed agricultural soil. 1221, RH 4729.
- Porella cordeana* (Hübener) Moore [Porellaceae]. Among *Rhytidiadelphus triquetrus* among rocks over soil, concrete in ephemeral streambed. 987, 1384.
- Porella navicularis* (Lehmann et. Lindenberg) Lindberg [Porellaceae]. Bark of Oregon white oak, Oregon ash, and Douglas fir; exposed basalt; shaded basalt. 603, 1116.
- Porella roellii* Stephani [Porellaceae]. Oregon white oak bark, rotting bigleaf maple log. 604, 613.
- Radula bolanderi* Gottsche [Radulaceae]. Douglas fir bark. 645.
- Radula complanata* (L.) Dumortier [Radulaceae]. Oregon ash bark; vine maple bark; rotting branch. 640, 685, 968a.
- Riccardia multifida* (L.) S. Gray [Aneuraceae]. Crumbling undercut creekbank soil. 876.
- Riccia* spp. [Ricciaceae]. Undrained agricultural soils. 1565a, 1565b.
- Riccia fluitans* L. [Ricciaceae]. Streamside mud. 1153.
- Ricciocarpus natans* (L.) Corda [Ricciaceae]. Free-floating, shaded mud. 869, 884.
- Scapania bolanderi* Austin [Scapaniaceae]. Rotting stump on north-facing forested slope. 1208.
- Scapania umbrosa* (Schrader) Dumortier [Scapaniaceae]. Rotting Oregon white oak branch on north-facing forested slope. 1437.

#### Class Anthocerotae

- Anthoceros sensu lato* sp. [Anthocerotaceae]. North underhand of *Juncus* hummock in native wet prairie. 1568.

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